EEE 313 - Electronic Circuit Design - Lab 1 Experimental Report
Tuna Şahin - Diode based Temperature Sensor

Preliminary Recap:

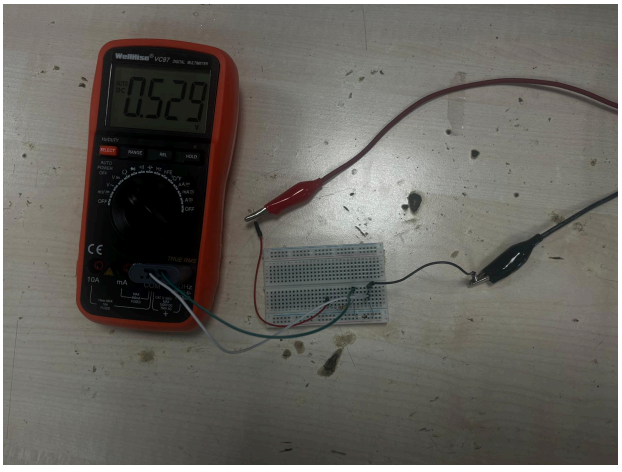
In our preliminary report, we were asked to implement a circuit that measured the temperature difference between two diodes and turn on a LED if the difference exceeded 5K. While implementing this, we had some criteria that we had to satisfy. We were also asked to measure the I_s of a diode.

- The voltage of the difference amplifier should output 2V when the diodes' temperatures are equal.
- The difference amplifier output should change with 1V/K.
- The LED should turn on when the difference exceeds 5V.
- The comparator output should have a hysteresis value of 0.1V so that it does not flicker around the threshold.

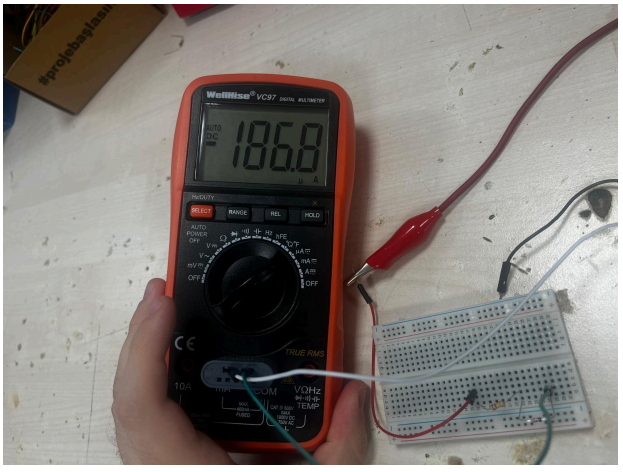
Component List:

- 2 x 1N4148 Diode
- 1 x LM358 Dual Opamp
- 1 x Red LED
- 1 x 100nF capacitor
- 1 x 10kΩ potentiometer
- 2 x 12kΩ resistor
- 2 x 68kΩ resistor
- 2 x 120kΩ resistor
- 4 x 2.2kΩ resistor
- 4 x 1.2MΩ resistor
- 1 x 2.7kΩ resistor
- 1 x 33kΩ resistor
- 2 x 1kΩ resistor
- 1 x 100kΩ resistor
- 1 x 390kΩ resistor
- 1 x 680Ω resistor

Measurements:



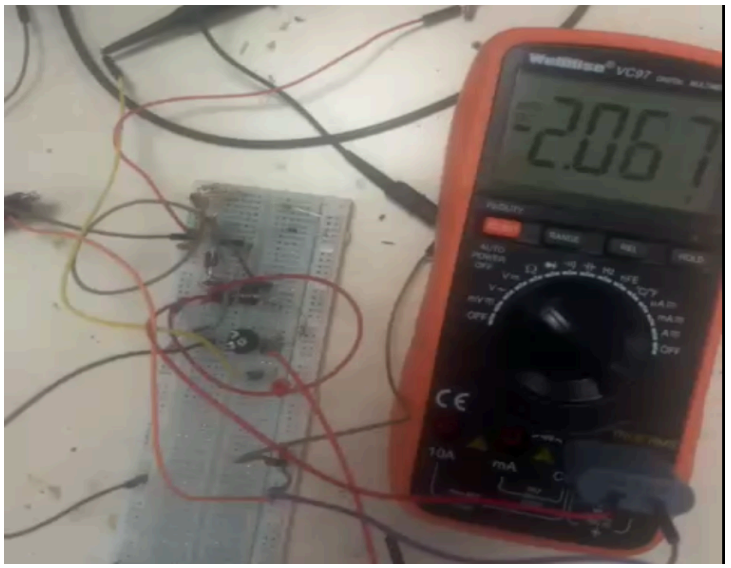
Diode voltage = 0.529V



Diode current = $186\mu A$

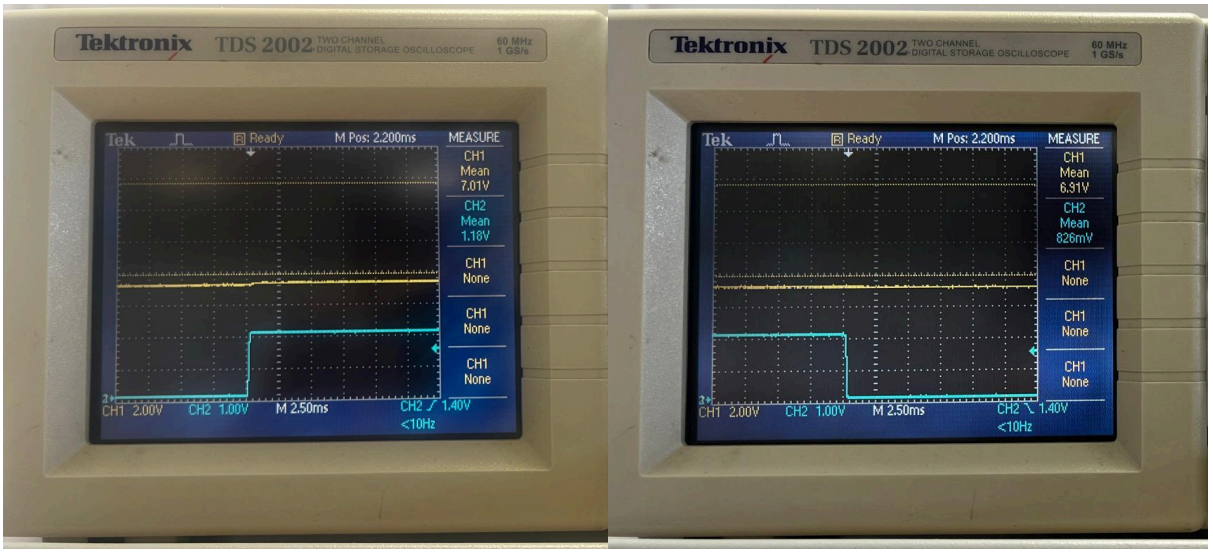
From these values we can calculate the I_s as: $I_S = \frac{I_D}{exp(\frac{V_D}{nV_t}-1)} = \frac{186\,.\,10^{-6}}{exp(\frac{0.526}{1.752\,.\,0.026}-1)} = 4.5nA$

Even though LTSpice shows I_s as 2.52nA, datasheet of 1N4148 shows I_s as 4.5nA.



1. Voltage reading of V_{out} can be seen as 2V when no heat is being applied.

2. Unfortunately, since we do not have a way of accurately measuring the temperature, we could not verify that V_{out} had a increase of 1V/K



The blue line (CH2) shows the voltage of the LED and the yellow line (CH1) is V_{out}

3. We can observe that the LED turns on at 7V which is 2V + 5V which is the given threshold.

4. I set up the trigger so that the oscilloscope freezes the voltages the instant LED turns on and off. The photo on the left shows the rising edge while the photo on the right shows the falling edge. We can then observe that the LED turns on at V_{out} =7.01V while it turns off at V_{out} =6.91. Giving us a hysteresis value of 0.1V.
5. I have also recorded a video showing the circuit along with the measurement of V_{out}
   Video Link: https://youtu.be/2rQr9d_DiHc